

REMARKS

This is a response to the Office action dated July 12, 2005. Applicants have amended claims 1-6, 9-11, 13-14, 16-17, 22 and 25 and added new claims 26-32. Claims 1-32 are presented for examination. Applicants request reexamination and reconsideration of application.

In paragraph no. 1 of the Office action, the Examiner objects to the abstract because it exceeds 150 words. Applicants amend the abstract so as to be less than 150 words.

In paragraph no. 2 of the Office action, the Examiner objects to claims 1 - 25 for the following informalities:

With regard to claims 1, 6, 14, 17, 22, and 25, the Examiner objects to the acronym VLUN and suggests it be spelled out. Applicants amend claims 1, 6, 14, 17, 22, and 25 to spell out the acronym VLUN as virtual logical unit number as suggested by the Examiner.

With regard to claim 14, the Examiner objects to the phrase "the bitmaps" and "the log files" and suggests they be changed to "bitmaps" and "log files", respectively. Applicants amend claim 14 to bitmaps and log files as suggested by the Examiner.

With regard to claim 25, the Examiner objects to the phrase "the target VLUN" and "the original dirty data" and suggests they be changed to "a target VLUN" and "original dirty data", respectively. Applicants amend claim 25 as suggested by the Examiner.

With regard to claim 16, the Examiner objects to the phrase "the target destage operation" and suggests it be changed to "a destaging operation." Applicants note this claim reads on Figure 4 and have amended claim 16 as follows:

The method of claim 14, further comprising writing the log files and the bitmaps to the target VLUN, removing a dirty data designation for the destaged original data still in the cache memory and sending destage operation complete status.

In view of the above amendments, applicants submit the objections are overcome with respect to dependent claims 2-5, 7-13, 15, 18-21, and 23-24.

1 In paragraph no. 3 of the Office action, the Examiner rejects claims 9, 10, and 13-16
2 under 35 USC 112, second paragraph, as being indefinite.

3 With regard to claims 10 and 13, the Examiner states "the first log file" and "the second
4 log file" lack an antecedent basis. Applicants amend claim 14 to recite "a first log file"
5 and "a second log file."
6

7 With regard to claim 9, the Examiner states "the bit map" and "the bit map" lack an
8 antecedent basis. Applicants amend claim 9 to recite "a first bit map" and "a second bit
9 map."

10 With regard to claim 14, the Examiner states "the snapshots" lack an antecedent basis.
11 Applicants amend claim 14 to provide an antecedent basis in the preamble.

12 With regard to claim 16, the Examiner states "the dirty data designation" and "the log
13 file" and "the bitmap" lack an antecedent basis. Amended claim 16 as described earlier.
14 overcomes this rejection.
15

16 In paragraph no. 4 of the Office action, the Examiner rejects claims 1, 2, 4, 6, 7, 12, 17,
17 and 19 under 35 USC 102(e) as being anticipated by US Patent No. 6,434,681 B1 to
18 Armangau (Armangau).

19 Armangau cannot anticipate claim 1 because claim 1 as amended requires a method of
20 snapshot operation, comprising:

21 generating first metadata to locate first snapshot data and to indicate when the
22 first snapshot data is in the target VLUN; and

23 generating second metadata to locate second snapshot data and to indicate
24 when the second snapshot data is in the target VLUN, wherein the first and second
25 metadata locate an original data element of the first snapshot data and of the second
26 snapshot data at the same address in the target VLUN.
27

28 Figure 7 illustrates this method is very different than Armangau's snapshot operation. As
29 a reminder, the present application uses letters such as A, B, or C to represent data
30 elements (e.g., files, data blocks, or records) and subscripts to indicate the version of
the data element. Referring to step 1 of Figure 7, after creating a second snapshot, an

1 application may modify a data element, that is, B_0 to B_1 . At step 2, the system allocates
2 and writes the modified data element B_1 to a new cache line. At step 3, the data
3 storage system writes the original data element B_0 to the target VLUN to preserve the
4 original data element of the first snapshot and of the second snapshot. At steps 4-7, the
5 data storage system adds first and second metadata to locate the original data element
6 of the first snapshot data and of the second snapshot data at the same address in the
7 target VLUN. Thus, method claim 1 does not require additional space for an original
8 data element common to multiple snapshots.

9 Armagau fails to suggest any snapshot tracks share an original data element much less
10 how to locate an original data element of the first snapshot data and of the second
11 snapshot data at the same address in a target VLUN. Instead, Armangau snapshots
12 each track of production volumes (e.g., tracks A, B, G, and H) to a separate location
13 (e.g., tracks 0, 1, 2, and 3) of the snapshot volume, rapidly expanding the snapshot
14 volume requirements, even when multiple snapshots share original data elements.

15 In view of the above, applicants respectfully submit that amended claim 1 and its
16 dependent claims 2-5 are allowable for the same reasons presented in connection with
17 claim 1 as well as the additional limitations recited in each dependent claim.
18

19 Amended claim 6 and its dependent claims 7-13 are patentably over Armangau for
20 reasons similar to those presented in connection with amended claim 1.

21 In paragraph no. 5 of the Office action, the Examiner rejects claim 25 under 35 USC
22 103(a) as being unpatentable over Armangau.

23 Amended claim 25 recites a method of error recovery in a data storage system
24 comprising:
25

- 26 (a) reading a bitmap, wherein if the bitmap contains a value in a state
27 representing original dirty data in cache memory, destaging the data to the target VLUN,
28 and wherein if the bitmap contains an inverse value in the bit position representing the
29 presence of associated original data in the target VLUN, not destaging the data;
30 (b) removing the dirty data designation for the destaged data; and
(c) repeating the steps (a) and (b) until all of the original dirty data is destaged.

1 Armangau cannot render amended claim 25 obvious because it fails to describe this
2 method of error recovery. Armagau's bitmaps indicate production tracks that have not
3 been modified since the time a snapshot copy was created and will be snapshotted
4 before allowing a write to the production tracks. The snapshot copy taken earlier should
5 be sufficient to preserve an unmodified production track (see columns 2-3 of Armangau)
6 so Armangau's purpose is uncertain. In any event, Armagau's fails to enable error
7 recovery as recited in amended claim 25. The bitmaps do not represent original dirty
8 data in cache nor destaged data in a target VLUN and Armangau fails to describe
9 removing the dirty data designations for the destaged original data. In view of the
10 above, it is respectfully submitted amended claim 25 is patentable over Armangau.

11 In paragraph no. 6 of the Office action, the Examiner stated no prior art was applied to
12 claims 9-10 and 13-16 due to the ambiguities set forth above under 35 USC 112,
13 second paragraph.

14
15 Applicants submit the previous remarks demonstrate claims 9-10 and 13-16 are
16 patentable with respect to the rejections set forth in paragraph no. 3 of the Office action,
17 and are patentable with respect to Armangau.

18 In paragraph no. 7 of the Office action, the Examiner stated dependent claims 3, 5, 8,
19 11, 18, and 20-24 would be allowable if rewritten in independent form.

20 In paragraph no. 8 of the Office action, the Examiner states reasons for allowance of
21 claims 3, 8-10, 11, 13, 14, 18, 20-22 and states claims 5, 15-16, and 23-24 further limit
22 claims 3, 14, and 22, respectively, therefore they too are deemed allowable.

23
24 Claims 3, 5, 8, 11, 18, 20, 21, are rewritten as new claims 26-32, respectively, with
25 minor modifications, while claim 22 is not rewritten since claim 22 is already in
26 independent form and claim 23-24 dependent therefrom.

27 Applicants agree claims 3, 5, 8-11, 13-16, 18, 20-24 are allowable but note each claim
28 is patentable based on its entire subject matter rather than a certain limitation.
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1 Please call if you have any question, comment, or it will expedite prosecution.

2
3 Respectfully Submitted,

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